

WHAT IS CLAIMED IS:

1. A method for hydrogen production comprising the steps of:
introducing a feedstock comprising at least one biodegradable solid into
a first stage anaerobic bioreactor and forming a liquid effluent;
transferring said liquid effluent into a second stage anaerobic bioreactor
having a plurality of hollow semipermeable fibers having an outer surface coated with
a biofilm comprising at least one hydrogenogenic bacteria, forming hydrogen within
lumen of said hollow semipermeable fibers; and
removing said hydrogen from within said lumen of said hollow
semipermeable fibers.
2. A method in accordance with Claim 1, wherein said first stage
anaerobic bioreactor is operated with substantially zero headspace.
3. A method in accordance with Claim 1, wherein a retention time
for said feedstock in said first stage anaerobic bioreactor is sufficiently short whereby
establishment of methanogenic bacteria in said first stage anaerobic bioreactor is
substantially prevented.
4. A method in accordance with Claim 1, wherein said first stage
anaerobic bioreactor is operated under thermophilic conditions.

5. A method in accordance with Claim 4, wherein said first stage anaerobic bioreactor is operated at a temperature in a range of about 45°C to about 65°C.

6. A method in accordance with Claim 1 further comprising adding a methanogenic bacteria specific chemical inhibitor to said second stage anaerobic bioreactor.

7. A method in accordance with Claim 1, wherein said second stage anaerobic bioreactor is maintained at a hydraulic retention time in a range of about 24 hours to about 48 hours.

8. A method in accordance with Claim 1, wherein CO₂ is formed in said lumen from which it is transmitted through a CO₂ scrubber system whereby said CO₂ is recovered.

9. A method in accordance with Claim 1, wherein said first stage anaerobic bioreactor generates biosolids.

10. A system for producing hydrogen comprising:

a first stage anaerobic bioreactor vessel having a feedstock inlet and a liquid effluent outlet;

a second stage anaerobic bioreactor vessel having a liquid effluent inlet in fluid communication with said liquid effluent outlet and a hydrogen gas outlet; and

a plurality of hollow semipermeable fibers disposed in said second stage anaerobic bioreactor vessel, said plurality of hollow semipermeable fibers having an outer surface coated with a biofilm comprising at least one hydrogenogenic bacteria.

11. A system in accordance with Claim 10, wherein said first stage anaerobic bioreactor vessel is operable at substantially zero headspace.

12. A system in accordance with Claim 10 further comprising recycle means for recycling a portion of said liquid effluent disposed in said second stage anaerobic bioreactor vessel into said first stage anaerobic bioreactor vessel.

13. A system in accordance with Claim 10 further comprising a CO₂ scrubber system having a gas inlet in fluid communication with said hydrogen gas outlet.

14. A system in accordance with Claim 10 wherein said at least one hydrogenogenic bacteria is an axenic culture.

15. A system in accordance with Claim 10, wherein said at least one hydrogenogenic bacteria is a mixed culture.

16. A system in accordance with Claim 10, wherein said first stage anaerobic bioreactor vessel and said second stage anaerobic bioreactor vessel are constantly stirred tank reactors.